CLAIMS

What is claimed is:

1. A method for demodulating data from a channel, comprising:

receiving *a priori* probability values for symbols transmitted across the channel;

in accordance with the *a priori* probability values, determining a set of Monte Carlo samples of the symbols weighted with respect to a probability distribution of the symbols; and

estimating *a posteriori* probability values for the symbols based on the set of Monte Carlo samples.

2. The method of claim 1, wherein:

the *a priori* probability values are represented by $P(s_k=a_i)$, where the symbols in a symbol interval are represented by s_k, and k is an index identifying a transmit antenna; and

a_i is an ith value in an alphabet set from which the symbols take their values.

3. The method of claim 1, wherein:

the Monte Carlo samples comprise stochastic Monte Carlo samples.

4. The method of claim 1, wherein:

the probability distribution of the symbols is represented by $p(\mathbf{s} \mid \mathbf{z})$, where $\mathbf{s}$ is a vector of transmitted signal values for different transmit antennas in a symbol interval, and $\mathbf{z}$ is a vector of received signals from the different transmit antennas after nulling.

5. The method of claim 1, wherein determining the set of Monte Carlo samples of the symbols in a symbol interval, represented by $\{(s_k^{(j)}, w_k^{(j)})\}$, comprises:

determining a trial sampling density for each ith value, a_i, in an alphabet set A from which the symbols take their values, using the *a priori* probability value $P(s_k=a_i)$ from a previous iteration, where the symbols are represented by s_k, and k is an index identifying a transmit antenna;

drawing the jth sample symbol $s_k^{(j)}$, from the alphabet set A, where j=1,2,...,m, and m is a number of the Monte Carlo samples determined for the symbol interval; and

computing an importance weight $w_k^{(j)}$ for $s_k^{(j)}$.

6. The method of claim 5, further comprising:

performing resampling to obtain updated importance weights $w_k^{(j)}$.

7. The method of claim 5, further comprising:

initializing the importance weights $w_{-1}(j)=1$.

8. The method of claim 1, wherein:

m is a number of the Monte Carlo samples determined for a symbol interval;

the Monte Carlo samples are represented by $\{(s_k^{(j)}, w_k^{(j)})\}$,

each *a posteriori* probability value $P(s_k=a_i \mid \mathbf{z})$ is obtained from

$$P(s_k=a_i \mid \mathbf{z})= \frac{1}{W_k}\sum_{j=1}^{m} 1(s_k^{(j)}=a_i)\, w_k^{(j)}, a_i \in \mathbf{A} \text{ where}$$

z is a vector of received signals from different transmit antennas after nulling;

the symbols are represented by s_k, where k is an index identifying a transmit antenna;

importance weights for the symbols s_k are represented by w_k;

A is an alphabet set from which the symbols take their values, and a_i is an ith value in A;

$W_k \triangleq \sum_{j=1}^{m} w_k^{(j)}$; and

1 is an indicator function defined by $1(x = a) = \begin{cases} 1, & \text{if } x = a, \\ 0, & \text{if } x \neq a. \end{cases}$.

9. The method of claim 1, further comprising:

based on the *a posteriori* probability values, calculating *a posteriori* log-likelihood ratios of interleaved code bits.

10. The method of claim 1, wherein:

the Monte Carlo samples comprise deterministic Monte Carlo samples.

11. The method of claim 1, wherein determining the set of Monte Carlo samples of the symbols in a symbol interval, represented by $\{(s_k^{(j)}, w_k^{(j)})\}$, comprises:

calculating an exact expression for the probability distribution by enumerating m samples for less than all transmit antennas to obtain m data sequences, where m is a number of the Monte Carlo samples determined for the symbol interval;

computing the importance weight $w_k^{(j)}$ for each symbol $s_k^{(j)}$, where k is an index identifying a transmit antenna; and

selecting and preserving m distinct data sequences with the highest weights.

12. The method of claim 1, wherein:

the channel comprises a multiple-input multiple-output (MIMO) channel.

13. A program storage device tangibly embodying a program of instructions executable by a machine to perform a method for demodulating data from a channel, the method comprising:

receiving *a priori* probability values for symbols transmitted across the channel;

in accordance with the *a priori* probability values, determining a set of Monte Carlo samples of the symbols weighted with respect to a probability distribution of the symbols; and

estimating *a posteriori* probability values for the symbols based on the set of Monte Carlo samples.

14. A demodulator for demodulating data from a channel, comprising:

means for receiving *a priori* probability values for symbols transmitted across the channel;

means for determining, in accordance with the *a priori* probability values, a set of Monte Carlo samples of the symbols weighted with respect to a probability distribution of the symbols; and

means for estimating *a posteriori* probability values for the symbols based on the set of Monte Carlo samples.

15. The demodulator of claim 14, wherein:

the Monte Carlo samples comprise stochastic Monte Carlo samples.

16. The demodulator of claim 14, wherein:

the Monte Carlo samples comprise deterministic Monte Carlo samples.

17. The demodulator of claim 14, wherein:

the channel comprises a multiple-input multiple-output (MIMO) channel.

18. A receiver for receiving data from a channel, comprising:

a soft outer channel decoder;

a soft inner demodulator; and

a symbol probability computer; wherein:

the symbol probability computer calculates *a priori* symbol probability values based on bit data received from the soft outer channel decoder; and

the soft inner demodulator, in accordance with the *a priori* probability values, determines a set of Monte Carlo samples of the symbols weighted with respect to a probability distribution of the symbols, and estimates *a posteriori* probability values for the symbols based on the set of Monte Carlo samples.

19. The receiver of claim 18, further comprising:

a bit log likelihood ratio computer that is responsive to the *a posteriori* probability values for determining *a posteriori* log-likelihood ratios (LLRs) of the bit data.

20. The receiver of claim 18, wherein:

the channel from which the data is received is a multiple-input multiple-output (MIMO) channel.